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A GEOGRAPHIC INTERPRETATION OF NEW YORK CITY.

BY

F. V. EMERSON.

Compared with many sciences of equal rank and age, geography has but little changed its aim and scope. Beginning as a most inclusive science which dealt with descriptions and observations relating to the entire visible universe, the science has narrowed with the separation from the parent science of geology, meteorology, anthropology, sociology, and phases of other sciences—but still holds rather closely to the meaning expressed by its etymology—earth science. The content of the science has been, and, to a great extent, still remains, the description of the surface of the earth and its peoples, together with any reflections and observations that present themselves to the writer. Perhaps the best efforts of geographers have been given to exploring and mapping the earth's surface, and such work is absolutely a necessary precedent to further description. Such work, although of great value, does not reach its highest value when it remains almost entirely descriptive.

With the general enrichment and increase in the content of all the other sciences, geography has slowly been assuming a new aspect. The facts of location which constituted the principal content of the old geography demand explanation. As a consequence, more attention is being given to the *relations* of geographic facts and factors. Ritter, Guyot, Ratzel, and many others have given a new outlook by their labors along this line of correlation. Their working definition of geography may be summarized in the statement that geography treats of the earth as the home of man—that is, it considers those earth influences that affect man. The earth in this sense includes the land, the seas, and the atmosphere. Davis would enlarge this definition to include *all* life responses to earth conditions and would add plants and animals to the organic factors of geography.† Mill states the idea somewhat differently by emphasizing geography as the science of distribution, and would include facts of distribution

* A part of the work on this paper was done in a seminar course with Professor J. Paul Goode of the University of Chicago, to whom the author is indebted for suggestions.

† *Geography in the United States*, W. M. Davis; *Science*, Jan. 22, 1904.

not strictly earth-controlled, such, for example, as some governments.*

One concept of geography in preparing this paper is similar to that of Mill. Geography under the conception set forth consists of two great factors, the inorganic and the organic. The inorganic factors to which life must adjust itself divide themselves into three great classes: viz., the position upon the globe, the terrane, and the climate. The organic factors may be divided into three classes—plants, animals and man. The following outline presents the scheme somewhat amplified:

I.—*Inorganic Factors.*

1. Position.

Latitude and longitude.
Distance and direction.

2. The Terrane.

Geological structure.
Soils, mineral locations.
Relief.
Hydrography.

3. Climate.

Temperature.
Moisture.
Winds.

II.—*Organic Factors.*

1. Plants.

2. Animals.

3. Man.

Sociological.
Economic.

Many of these factors are shared with other sciences, and this is especially true with the organic factors. Duplication and overlapping are inevitable and, of course, desirable in presenting and correlating facts. The test of a geographic fact is the determination as to whether it shows a genetic relation between an earth factor and an organic factor.

The purpose of this paper is to consider the fundamental geographic facts in the growth of New York City. The factors that have not had an important determinative influence have been omitted.

THE POSITION OF NEW YORK.—“An Athenian set down in a modern city would have wondered why they had neglected the best sites.”† Athens grew, not at her harbor Piræus, but around a fortified hill several miles distant. Rome flourished not at the mouth of the Tiber, where she would have been accessible to the Mediterranean pirates and maritime marauders, but at a point of greater safety in the interior. Paris grew on an island whose natural moat gave added security, and London began well back from the coast.

* The International Geography, H. R. Mill, 1900, p. 2.

† *Rise of American Cities*, A. B. Hart; *Quar. Jour. Econ.*, 4:129.

The modern city is an expression of factors somewhat different from those of the ancient or mediæval. The factor of easy defence, although not to be neglected, is subordinate to factors of commercial and industrial growth. Easy defence may be influential in determining the *location*, but the subsequent *growth* is determined by the usefulness of the site for commerce and industry. The modern city is a focus of activity for the tributary territory or hinterland.

New York City is what it is, primarily, because of its location, its local hinterland, its relation to other parts of the earth or its larger hinterland, and to social and economic factors, in part geographic and in part independent of geographic conditions.

The city is located at the western border of the narrow Atlantic in the latitude that includes the most active and masterful of the world's people. This latitude insured the peopling of the hinterland with Caucasian folk who had been developing for centuries, and whose previous experience enabled them to continue their civilization in the new land without any serious interruption.

Back of New York the great Atlantic slope stretches to the Rockies; in front, across the Atlantic, the Atlantic slope of Europe faces toward the West, a most important fact.* New York thus is in the zone of greatest activity, commercial and intellectual. As yet the great routes of commerce follow the parallels instead of the meridians, although this condition is not likely to be as persistent in the future as in the past.

The longitude of New York is about 3,000 miles west from the centre of the land hemisphere, a commercial location of some advantage as a medial point between Occidental Europe and the Orient. This advantage, however, is more for the future than it has been for the past.

The problem of distance and direction is one that this port must meet as a candidate for world commerce. The transfer of freight must always be influenced by distance, though the prospect of return cargo, weather, and a host of other factors, may mask the influence of distance. This influence, however, is permanent and counts strongly in the long run.

In distance from Europe, New York has an advantage over most other ports of the Atlantic and Pacific coast, Boston being the only large city more favourably situated on the American seaboard. The sailing distances between London and some American ports are:

* *Politische Geographie der Vereinigten Staaten*, Ratzel, 1893, p. 13.

New York, 3,330 miles; Philadelphia, 3,500 miles; Quebec, 2,850 miles; Boston, 3,200 miles; San Francisco, about 8,000 miles *via* the Isthmus of Panama.

In the competition for world's commerce the distance of New York and London from various ports is shown by the following table, the navigation distance instead of the shortest distance being taken:*

	NEW YORK.	LONDON.
Alexandria	6,503	3,097
Buenos Ayres.....	9,795	6,298
Capetown	5,142	6,117
Hong Kong.....	11,580	9,688
Melbourne	12,586	11,055
Rio de Janeiro.....	4,748	5,204
Shanghai	12,324	10,437
Singapore	10,141	8,248

New York, it will be seen, is one of the most favourably situated cities on the Atlantic seaboard so far as distance from Europe is concerned. So far as European rivals are concerned, New York is favourably situated with regard to South American and Asiatic ports, although not so favourably situated as ports further south on the Atlantic seaboard. This handicap of distance is likely to tell against New York when the Panama Canal shall have been opened.

There have been two interesting investigations dealing with the value of the factor of distance as affecting New York and her great rivals, Philadelphia and Baltimore.

After a period of rate wars between the Baltimore and Ohio, the Pennsylvania, the Erie, and the New York Central for the export trade from Chicago and St. Louis, it was agreed to submit the question of rates to a Board consisting of Messrs. A. G. Thurman, E. B. Washburne, and T. M. Cooley. This board met in 1882 and after hearing testimony awarded a differential rate in favour of Baltimore of three cents per hundredweight and in favour of Philadelphia of two cents. The Board in the report makes the award upon three considerations—distance, cost, and competition. The shortest rail line from Chicago, according to their conclusion, was as follows: Boston, 1,009 miles; New York, 900 miles; Philadelphia, 823 miles; Baltimore, 802 miles—an evident handicap upon New York of eight per cent. with respect to Philadelphia, and eleven per cent. against Boston. At the rates prevailing in 1882, the Commission stated that

* Table of Distances, U. S. Hydrographic Office.

the proposed differential would favour Philadelphia only six and two-thirds per cent. and Baltimore ten per cent. The New York people demurred and claimed that actual cost and not distance should prevail in the consideration.

In respect to cost, the Commission confessed itself unable to decide, owing to a lack of definite statistics. The New York Central claimed advantages of grades, but did not substantiate the claims with facts. The Pennsylvania and Baltimore and Ohio admitted the lower grades of the New York Central but claimed that fuel cost them one-third less.

The Commission found that in 1881 competitive ocean rates to Europe were three cents per hundredweight more for Baltimore and two cents per hundredweight more for Philadelphia. The better facilities at New York for distribution and the greater assurance there of west-bound freight together with the lower ocean rates convinced the Commission that the differential rate was justified. They took no action with respect to Boston, since Boston railroads were not a party to the controversy.* These rates prevailed until 1900, when they were lowered one half in each case. At that time Newport News and Norfolk were included in the Baltimore schedule.

Somewhat earlier a Commission headed by Mr. Hepburn made an exhaustive examination of the question. The testimony fills five volumes and was submitted to the New York Legislature February 28, 1879. The general conclusion was that the differential was unjust to New York and prevented her from enjoying her geographic privileges. Nevertheless, the rates have stood, at least so far as published rates are concerned.

So many factors, geographic and economic, enter into the discussion of the rates in these cases that about the only value of the investigation, so far as this paper is concerned, is to emphasize the favourable position of New York for commerce with Europe. It would seem that the conviction of the Hepburn Commission is in part true. With a car loaded and the train in motion, a distance of one hundred miles is almost inappreciable in the cost of transporting a train load of freight.† The factor of cheap coal is somewhat against New York although the anthracite fields are not distant.

THE LOCAL HINTERLAND.—The history of New York City might be divided into two periods. In the first period the hinterland was

* *Report of the Advisory Commission on Differential Rates; Railroad Gazette*, July 28, 1882, pp. 453-7.

† Report, Hepburn Commission, Vol. V, p. 23. See also, *The Growth of Cities*, A. F. Weber 1905, p. 204.

local and the city was provincial. With the opening of the Erie Canal a new hinterland was opened, and the city became more and more metropolitan. Each hinterland will be separately described, together with its geographic responses. The plan followed will be to begin at the city itself, and describe the various portions of the hinterland with reference to the city as a centre. New York is near

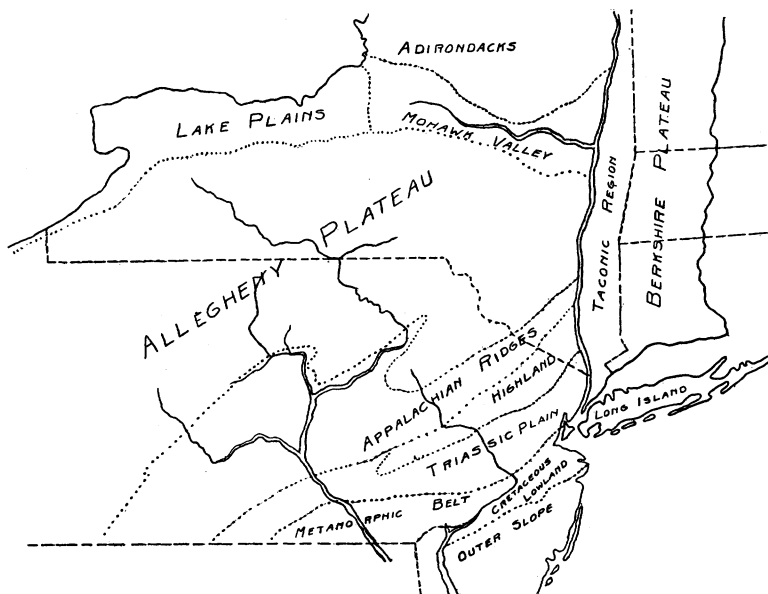


FIG. 1.—Divisions of the Local Hinterland of New York. From State Geological Maps; Pennsylvania, 1893; New Jersey, 1901; New York, 1901.

the meeting of several geological formations, each having a characteristic structure and topography. The principal divisions are shown in the map. (Fig. 1.)

THE HIGHLANDS.—The city is built on a complex of partially metamorphosed rocks known as the Highland belt. It is a hilly region for the most part and stands above the country on either side with an average elevation in New Jersey of about 1,000 feet.* It is a well-dissected region with considerable relief, having ridges and uplands from 500 to 1,000 feet higher than the valleys.† There is a sharp contrast between the glaciated and unglaciated portions. In 1888 75% of the glaciated area in the highlands was forested, while south of the glaciated area only about 30% of the area was in

* New Jersey Geological Survey, Vol. IV, 1895, p. 103.

† New Jersey Geological Survey, Vol. I, 1888, p. 134.

forest.* The glacial soils in this province are more stony and less fertile than those of the unglaciated area.† The Highlands extend southwesterly and terminate in the vicinity of Reading, Pa.

THE TRIASSIC PLAIN.—In sharp contrast geologically to the Highlands is the Triassic Plain, lying to the southeast. The plain begins about thirty miles north of New York and extends southwest through Pennsylvania. The rocks are sedimentary, and, in the northern portion, especially, trap has been intruded into the series. The effect of erosion on such a structure has been a relief much less pronounced than that of the Highlands, with the exception of the trap ridges which stand out above the general level, where the trap outcrops. The plain slopes from a general altitude of about two hundred feet on the west to less than one hundred feet on the east.‡ Excepting in the northwest, where the Ramapo Mountains of the Highlands rise above the plain, there is no very sharp topographic division between the Triassic Plain and the Highlands on the northwest and the Coastal Plain on the southeast.§

The soils both on the unglaciated and glaciated portions of the Triassic Plain are in general good.|| The trap ridges do not yield good soil, but their area is inconsiderable.

THE COASTAL PLAIN.—Beginning in the vicinity of New York, the Coastal Plain widens as it extends southward. The rocks are sedimentary, generally unconsolidated, and dip gently eastward. The combination of soft Cretaceous shales and marls and more resistant overlying formations, both dipping eastward, has, in New Jersey, been eroded into two portions—the inner lowland which is the fertile Cretaceous plain, and the outer slope which is covered with less fertile Tertiary and Pleistocene deposits. The altitude of the inner lowland has a range from tide level to about one hundred and fifty feet, one third of the surface being below fifty feet.** Over one-half of the surface of southern New Jersey is below one hundred feet.†† The Cretaceous inner plain is a fertile region.‡‡ In contrast to the fertility of the inner plain, the outer slope of New Jersey is in general infertile.§§ (Fig. 2.)

* New Jersey Geological Survey, Annual Report, 1895, p. 101.

† New Jersey Geological Survey, Annual Report, 1898, p. 2.

‡ New Jersey Geological Survey, Vol. I, 1888, p. 152.

§ New Jersey Geological Survey, Vol. IV, 1895, p. 27.

|| New Jersey Geological Survey, Vol. I, 1888, p. 152. See also the Soil Survey of Trenton Area, 1902. (U. S. Soil Survey.)

** Geological Survey of New Jersey, Vol. I, 1881, p. 169.

†† Geological Survey of New Jersey, Vol. IV, 1895, p. 105.

‡‡ Geological Survey of New Jersey, Vol. IV, 1895, pp. 172-2.

§§ Geological Survey of New Jersey, Vol. I, 1881, pp. 173-8. See also the Soil Survey of the Trenton Area, 1902. (U. S. Soil Survey.)

The eastern slope of New Jersey continues beneath the Atlantic with a gentle slope. Such a shelving sea bottom, together with its unresistant materials, is, in general, unfavourable for the formation of harbours. The shallowness of the water prevents the approach of large vessels. There is a tendency towards the formation of off-shore bars. From Monmouth Beach to Bay Head, a distance of about nineteen miles, the waves are cutting a cliff,* north and south of which are wing-like bars.† The northern wing extends northward and becomes Sandy Hook at the entrance to Raritan Bay.

South of Bay Head is a line of off-shore bars with occasional inlets and with shallow lagoons between the bars and the mainland.

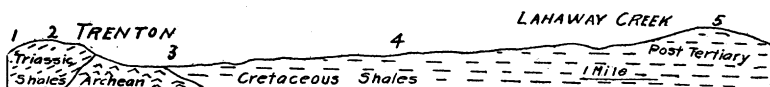


FIG. 2.—Generalized soil section from the vicinity of Trenton, N. J., southwest to the vicinity of Midwood. Soil types: (1) Penn loam, derived from Triassic shales; (2) Sassafraz loam, a sedimentary soil here overlying the Triassic shales; (3) Elsinboro fine sand; (4) Collington sandy loam, a fertile soil derived from glauconitic Cretaceous shales; (5) Norfolk sand, a medium to coarse sand sedimentary in origin and infertile. Soil location and description from the U. S. Soil Survey of the Trenton Area, 1902; geology from the geological map of New Jersey, published by the State Geological Survey.

The inlets are difficult of access and some of the channels through them are shifting.‡ In consequence of these unfavourable conditions being where the lowland merges into a highland, the changes are of importance legally and commercially.

The belt between the Appalachian ridges and the Coastal Plain is usually termed the Piedmont. It will be referred to under that name in subsequent pages.

West of the Highlands is a region that has by some been included in the Highland Province. It is lower than the latter, and like it, has a metamorphic structure and hilly topography. Tarr correlates this with the Taconic Region at the northeast, the junction being where the lowland merges into a highland, the difference in altitude being due to the fact that the rocks of the Taconic region are more metamorphosed and therefore more resistant than on the south.§ This province extends along the northeastern border of the State eastward to the Connecticut River, and westward to the Appa-

* Annual Report, New Jersey Geological Survey, 1905, p. 28.

† Shore-line Topography, F. P. Gulliver. *Proc. Am. Acad. Arts and Sciences*, Vol. XXXIV, No. 8, Jan. 1899, p. 213.

‡ Geological Survey of New Jersey, 1905, p. 28.

§ Physical Geography of New York State, 1902, pp. 4-6.

lachian Ridges. Its rocks are highly metamorphosed and its topography, west of the Hudson, is rough. The region in the north has been strongly glaciated, most of the preglacial soil has been removed, and there has not been sufficient time since the glacial period for much new soil to form.

THE APPALACHIAN RIDGES.—West of the Highlands and Taconic belt is the region of folded sedimentary rocks. Beginning near Kingston, N. Y., the folded belt extends to Alabama. Erosion upon the folded structure has left the outcrops of hard rocks standing in relief as ridges, and the outcrops of less resistant rocks cut

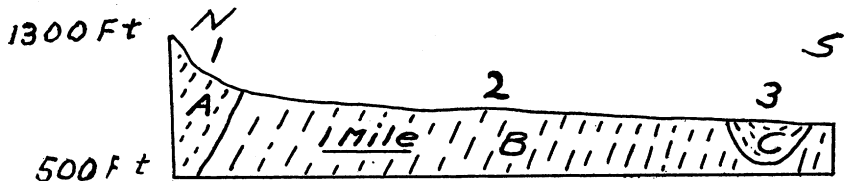


FIG. 3.—Profile and Section in Lower Paxton Township, Dauphin Co., Pa., from Blue Mountain southward. (1) Edgemont stony loam, derived from (A) Oneida-Medina sandstone; a sterile, stony soil on the steep ridge slopes, having only five per cent. under cultivation. (2) Hagerstown shale loam, derived from (B) Hudson River and Utica shales; it is a loamy soil of good quality. (3) Hagerstown loam, derived from (C) Cambro-Silurian limestone; it is a productive soil.

Data from Geological Map of Pennsylvania, 1893; Topographic Map of the Harrisburg Area; and U. S. Soil Survey Report of the Lebanon Area, Pa., 1901.

as valleys. The general result is a system of parallel ridges and valleys with a northeast-southwest trend. The streams in the valleys often turn abruptly and cut transverse gorges across the ridges. The ridges in New York are lower but rise in Pennsylvania to a general level of 1,500 to 1,800 feet, and farther south some of the ridges reach altitudes of over 3,000 feet.* The belt widens in Pennsylvania and in the northeastern part of this State contains one of the richest anthracite coal fields in the world. The soils in the valleys are often fertile, especially where they are residual and derived from shales or limestones. The ridges are infertile. They are usually composed of sandstone, quartzite or conglomerate, to the slow erosion of which they owe their existence, but which weather to a sandy, stony, infertile soil. The steep slopes favor an active drainage which carries away the finer particles and the soil does not retain enough moisture to favor the formation of humus. Figure 3 shows a soil section in the ridge belt of Pennsylvania.

* The Physiography of the United States, 1895, p. 175.

THE ALLEGHENY PLATEAU.—The Appalachian folded strata grade to the west and northwest into the nearly horizontal layers which form the structure of the Allegheny Plateau. This province extends northward to the Mohawk Valley and the Lake Plains, westward at least to central Ohio and southward to Alabama. The

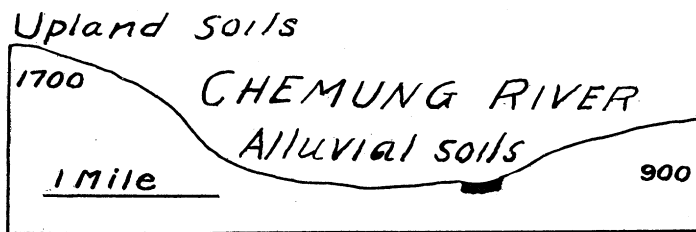


FIG. 4.—Profile of the Chemung River Valley ten miles southeast of Elmira, N. Y. The steep upland slopes are covered with a thin soil derived largely from the underlying Chemung shales. The valley soils are generally fertile. The figures indicate height above sea-level.

From the U. S. Soil Survey Report of the Big Flats, N. Y., Area. 1902.

surface is well dissected, with an average elevation in New York of at least 1,000 feet.* In general the plateau is capped by shales and sandstones. The capping shales and sandstones do not afford a very fertile soil and the glacial till soil in New York is not prominent except in the valleys and on the lowlands. Moreover, as in the Ridge belt, the steep slopes characteristic of the mature dissec-

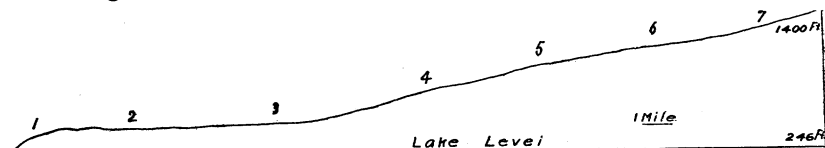


FIG. 5.—Generalized profile and soil section from Lake Ontario to the Allegheny Plateau, across Wayne and Cayuga and into Tompkins Counties, N. Y. Soil types: (1) Elmira silt loam; (2) Alton stony loam; (3) Miami stony loam; (4) Dunkirk clay loam; (5) Dunkirk loam; (6) Miami stony loam; (7) Volusia loam. The Elmira silt loam and the Dunkirk series were deposited in marginal glacial lakes, the most important of which in this locality were the glacial lakes Warren and Iroquois. They are, in general, good soils. The Alton stony loam and the Miami stony loam are derived from weathered drift. They are fair soils. The Volusia loam is largely residual and derived from local shales. The Volusia series are typical soils of the Allegheny Plateau in New York, Pennsylvania and Ohio. In general, the Volusia loam is the least productive of the types shown in this section.

From the following U. S. Soil Survey Reports: Lyons Area, 1902; Auburn Area, 1904; Tompkins County, 1906.

tion of the region do not make for the retention of fine soil particles or the formation of humus. The soils of the upland, which comprise a large percentage of the plateau, are therefore not fertile. They are in sharp contrast to the rather fertile soils of the valleys—a contrast brought out in those Soil Survey reports which include

* Tarr, *Physical Geography of New York State*, p. 8.

both valleys and uplands.* (Figs. 4, 5.)† This plateau on the east and north presents a dissected escarpment to the Hudson and Mohawk valleys. (Fig. 6.) About sixty miles north of New York the plateau is capped by sandstones and conglomerates. The result of erosion upon this structure is a region of steep-sided hills known as the Catskill Mountains. Further north, in the escarpment south of Albany, a durable layer of limestone overlying softer strata produces the Helderberg Mountains.

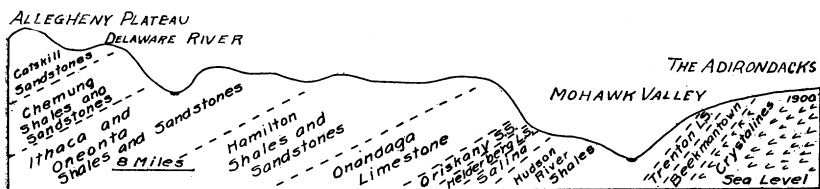


FIG. 6.—Profile and geological section showing: The Mohawk Valley, the Adirondacks on the north and the Allegheny Plateau and its escarpment overlooking the Mohawk Valley on the south. Taken near longitude $74^{\circ} 60'$ about 55 miles from the mouth of the Mohawk.

Profile from the following N. Y. topographic maps of the U. S. Geological Survey: Lassellville, Canajoharie, Richmondville, Hobart, Margarettsville. Geology from the N. Y. State Museum Map, 1901. The dip of the formations is conjectural and greatly exaggerated.

THE MOHAWK VALLEY.—North of the plateau in New York is a lowland belt extending across the State from Lake Erie to the Hudson.

From the Adirondack region, the sedimentary rocks underlying the Allegheny Plateau dip gently southward, lying unconformably upon the crystallines of the Adirondacks. Along the strikes of softer underlying formations, Brigham holds that the ancient Mohawk worked its way westward by headwater erosion.‡

This westward advance was arrested at Little Falls by a barrier of crystalline rocks which faulting had brought to the surface. This barrier, according to the same author, served as the preglacial divide between the Mohawk and a westward flowing stream. Later, at the time the drainage of the glacial Lake Iroquois was across this divide, the outflow both corraded the divide and aggraded its channel to the level

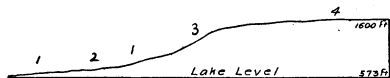


FIG. 7.—Section near Westfield, N. Y., from Lake Erie to the Allegheny Plateau. Soil types: (1) Clays for the most part deposited at the bottom of marginal glacial lakes. (2) Gravel and sand which formed shore lines of the lakes. (3) Residual soil derived from local shales. (4) Morainic soil much of which is derived from local shales.—From the U. S. Soil Survey Report of the Westfield, N. Y., Area, 1901.

* Soil Survey of the Big Flats Area, N. Y., 1902.

† Soil Survey of the Big Flats Area, N. Y., 1901.

‡ Bulletin Geol. Soc. Am., Vol. 9, 1898, pp. 183-210.

of the divide, and when the ice finally retreated so as to divert the drainage of Lake Iroquois to the north, the divide and the head of the Mohawk had shifted some ninety miles to the westward, near Rome, and the stream flowed over its level aggraded channel.* The result of this is a trench approximately 1,000 feet deep for much of its length, twelve to twenty miles wide, and about ninety miles in length, extending from the vicinity of Rome to the Hudson near Albany. The bottom of the trench descends from an elevation of about 445 feet at Rome, to sea-level at the Hudson, in a long, gradual slope to within a short distance of the Hudson. (See profile Fig. 6.) North of the valley is the Adirondack region, and south of it is the rather steep escarpment of the Allegheny Plateau. This plateau is a notable feature in New York, but it descends to the westward and in central Ohio it sinks to the general level. (Fig. 6). The soils of the Mohawk Valley are largely of alluvial, lacustrine, and, possibly, in part, of marine origin, and are fertile.

THE LAKE PLAINS.—Extending westward from the Mohawk Valley are the Lake Plains, which consist of three divisions, separated in the western part of the State by escarpments. A low, narrow plain rises 100 to 175 feet from Lake Ontario to the Niagara escarpment. Behind this escarpment, which is about 200 feet high, is the second plain, which extends southward a few miles to a low escarpment made by the resistant Corniferous limestone. The third plain lies further south, and merges into the Allegheny Plateau. These three plains form a series of steps to the plateau. The escarpments become less distinct from west to east, and the two lower plains merge into the Mohawk Valley at the indistinct divide near Rome. These plains were covered by the glacial lakes, Warren and Iroquois.†

The soils of the Lake Plains are varied. The till, largely derived from local limestones and shales, has plentiful mineral plant food. Intermingled with the till, or overlying it, are the shore and bottom deposits of the glacial lakes. The soils are generally fertile. A section through the lower plain up to the plateau shows the soils that are characteristic of the different agencies that have been at work. (Fig. 7; see also Fig. 5.)

THE HUDSON VALLEY.—The Hudson River is really an extension of the Mohawk so far as volume of water is concerned, since

* Brigham. *Ibid.*

H. L. Fairchild, N. Y. State Museum Report, No. 56, Part I, 1902, pp. 30-1.

† Frank Leverett, *Glacial Formations of the Erie and Ohio Basins*, Monograph 41, U. S. G. S., 901, pp. 68-74.

the former is an insignificant stream until the latter joins it. From the vicinity of Albany southward the Hudson is in a drowned river valley. The valley consists of an outer valley in which the geologically recent gorge-like valley is cut, this gorge being the drowned part.* The tidal influence extends to Troy above Albany. With the exception of the Mohawk, the Hudson has remarkably few and insignificant tributaries, and most of them enter from the west. The divide between the Hudson and the Connecticut, owing probably to the weak and few tributaries of the former and the strong and more numerous tributaries of the latter, is close to the Hudson Valley. There are few interlocking tributaries from the two rivers to form easy passes between the Hudson and the Connecticut valleys. During the glacial advances, the Hudson Valley, extending in the direction of ice movement, was an easy pathway for the ice, and is well scoured. This, together with the steep slopes and absence of any considerable flood plain, gives to the valley but little arable soil.

THE GREEN MOUNTAINS AND BERKSHIRE PLATEAU.—Between the Hudson Valley and the Connecticut Valley is a dissected upland, mountainous in the north and hilly in the south. The rocks are largely metamorphic, and in general folded.† The structure is com-

plex, and both the structure and its origin are yet a matter of controversy. The surface rises from the low hills near New York, to the short, sharp ridges west of the northern Hud-

son Valley. This region was strongly glaciated. The ice erosion swept away the preglacial soil, and at the recession of the ice the surface was partly covered with till. The hardness of the rocks over which the ice moved prevented their comminution by weathering to any extent and the residual till is very bouldery, often containing fifty per cent. of rock (Holyoke stony loam, Fig. 8). Moreover, the resistant rock in the till has not weathered enough in postglacial time to make much of its plant food available. The valleys are narrow

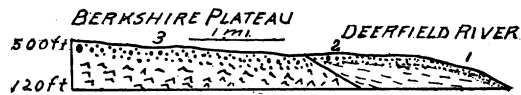


FIG. 8.—Soil section west of Deerfield, Mass. The section shows the change in soil types in passing from the Berkshire Plateau into the Connecticut Valley. (1) Hartford sandy loam of alluvial origin. (2) Triassic stony loam derived from the underlying Triassic sandstone. (3) Holyoke stony loam and rock outcrops. It is underlain, for the most part, by crystalline rocks and consists of stony till which contains 10 to 50 per cent. of boulders. Soil Survey of the Connecticut Valley, 1903.

* Tarr, *Physical Geography of New York State*, p. 188.

† T. Nelson Dale, *Taconic Physiography*, Bulletin 272, U. S. G. S., 1905, page 26.

and not in a stage mature enough for food plains to form. As in the case of the Allegheny Plateau, the steep slopes do not favor the accumulation of fertile soil. The soil in general in this region is infertile. In an area in the northern part, over seventeen per cent. is rock outcrop.*

LONG ISLAND.—Long Island, although not extensive, is important because of its nearness to New York. In structure it is a part of the Coastal Plain modified by ice. It is a long, narrow, low island, having a kind of double ridge or "backbone" in the northern part. The "backbone" consists of two moraines, the southerly one being the older. South of the older moraine is an extensive outwash plain. (Fig. 9.) The greater part of the island is covered by the sands and gravel of the outwash plains, and the soil has but little plant food.†

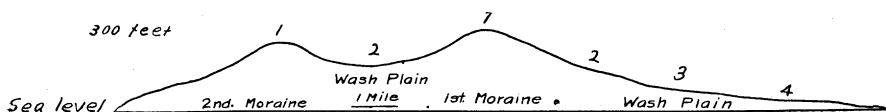


FIG. 9.—Generalized soil section in western Long Island near meridian $73^{\circ} 20'$. Babylon sheet, U. S. Soil Survey of Long Island, 1903. Vertical scale exaggerated about ten times. (1) Alton stony loam, composed largely of morainic sand and gravel with some Cretaceous clay. It is characteristic of the moraines. (2, 3, 4) Sassafras gravelly loam. Norfolk coarse sandy loam and Norfolk sand, respectively. They are characteristic of the outwash plains. The fineness increases from 2 to 4.

CLIMATE.—The States constituting the immediate hinterland of New York have a continental climate, except in the vicinity of the seacoast. The winters are long and severe and the summers short and hot. The precipitation ranges from thirty to fifty inches, and is in general sufficient for those crops which flourish in a region of moderate temperatures. The plains adjoining Lakes Erie and Ontario have a climate modified somewhat by the proximity of large bodies of water. This climatic modification has favoured the fruit orchards and vineyards that have sprung up on the plains overlooking the lakes.

THE RESPONSES TO THE EARLY HINTERLAND. POPULATION AND COMMERCE.—In the early part of the nineteenth century the seaport cities of Baltimore, Philadelphia, and New York turned their attention to the development of the trade in the trans-Allegheny region. The Atlantic slope was well populated in 1790 (Fig. 10), and it was realized that a limit was being approached in the development of the local hinterland. Hitherto the basis of the growth of

* Soil Survey of the Vergennes Area, New York and Vermont, 1904.

† Soil Survey of Long Island, 1903.

cities in America had been that of ancient and mediæval times, namely, the resources of the local hinterland. The commercial supremacy of the coast cities was to be decided by their success in gaining a commercial primacy in the larger hinterland beyond the Allegheny Plateau.

In the matter of a local hinterland, New York was at a disadvantage compared with the seaports to the south. The south-

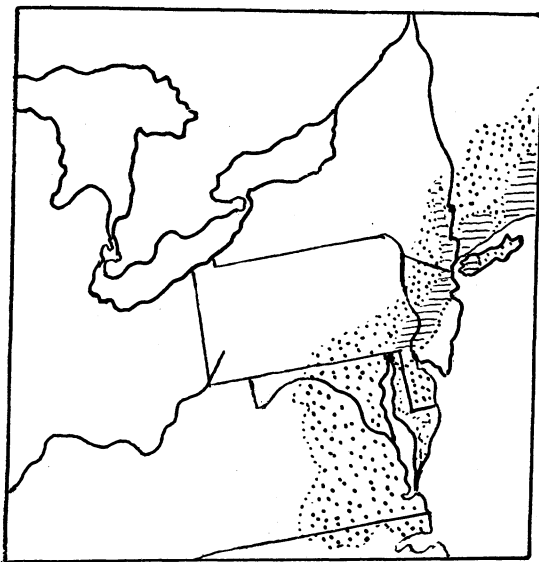


FIG. 10.—Population map of the United States in 1790. The dotted areas indicate a population of 18 to 45; the lined areas a population of 45 to 90 per square mile.

From the Statistical Atlas, 12th Census.

westward trend of the Appalachian ridges gave a widening belt of Piedmont and Coastal Plain back of the more southerly seaports.* The great Appalachian Valley, with its fertile soil (Fig. 3), also widens in the latitude of Philadelphia and Baltimore, and becomes accessible to those ports through the transverse valleys of the Delaware, Susquehanna, and Potomac. The hinterland of the southerly ports had a climatic advantage in that they could, without much competition, produce tobacco, for which there was a strong European demand. The Susquehanna tapped the territory northwest of New York and led its flour and wheat trade towards Philadelphia and Baltimore. To the fertile Piedmont and Shenan-

* For descriptions of the soils of the Piedmont, see the following U. S. Soil Survey Reports; Adams Co., Pa., 1904; Appomattox Co., Va., 1904; Harford Co., Md., 1901; Cecil Co., Md., 1900.

doah Valley, and to the transverse Susquehanna and Potomac, is undoubtedly due the fact that in the first quarter of the nineteenth century Baltimore was the leading flour market of America, as is shown by the following tables:

*Inspections of wheat flour:**

YEAR.	PHILADELPHIA.	NEW YORK.	BALTIMORE.
1813.....	359,000 bbl.	389,000 bbl.	291,000 bbl.
1815.....	335,000 "	312,000 "	388,000 "
1820.....	400,000 "	267,000 "	577,000 "
1825.....	294,000 "	446,000 "	510,000 "
1827.....	351,000 "	625,000 "	572,000 "

Boston had a well-peopled hinterland, but not the exclusive monopoly of trade which the Hudson and Delaware estuaries gave to New York and Philadelphia.

The productiveness of the local hinterlands is reflected in the wealth and population of the cities to which the hinterlands were tributary. Charleston and Philadelphia were leading centres of wealth and culture and Philadelphia was the metropolis until the early part of the nineteenth century. (Fig. 14.)

Population of:†

YEAR.	NEW YORK.	PHILADELPHIA.	BOSTON.
1722.....	....	...	10,567
1731.....	8,628	12,000	....
1765.....	....	....	15,520
1773.....	21,876	....	....
1790.....	33,131	43,520	18,038
1800.....	60,489	60,403	24,937
1810.....	96,373	99,874	33,250

It is not easy to account for the Colonial leadership of New York in view of its inferior local hinterland. The later growth of the city was probably largely due to the rapid opening to settlement of the Mohawk Valley region—a settlement that had been retarded by the presence of resident Indians. By 1820 a rather dense population extended across the State (Fig. 11). As early as 1795 the Mohawk was canalized, and much of the trade for the population of the valley centered at New York. The Cretaceous lowland and the Piedmont of New Jersey were densely settled, but they were

* Niles' Register, Vol. XXXIV, p. 238.

† Compendium of the Seventh Census, 1854, p. 192.

tributary to Philadelphia as well as to New York. New York was a centre of coastwise trade and by 1815 the enrolled tonnage in the trade in New York State exceeded that of any other State.*

In Colonial times New York and Pennsylvania were rivals in the export trade (Fig. 12), but by 1797 New York State led the Northern States in the value of its exports (Fig. 13). By 1810 New York City had a commerce far in excess of that of Phila-

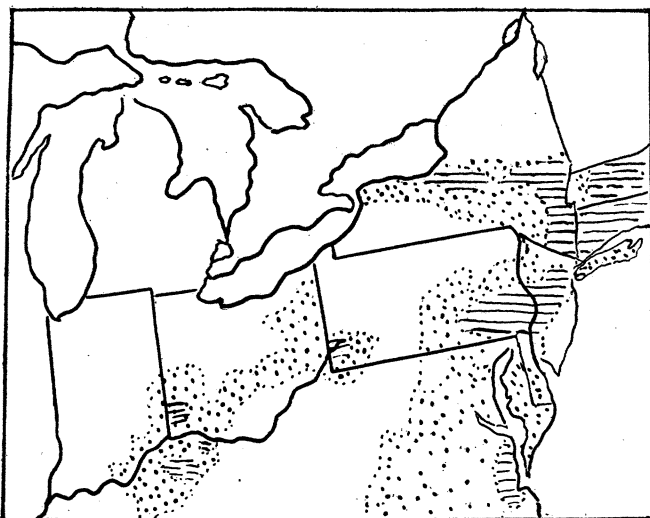


FIG. 11.—Population Map of the United States in 1820. The dotted areas indicate a population of 18 to 45; the lined areas a population of 45 to 90 per square mile. From the Statistical Atlas, 12th Census.

delphia. In the same year the tonnage owned in New York City by far exceeded that of any other American port, being twice that of Philadelphia.†

If we include in the population of the three cities the population within a radius of twenty-five and fifty miles from those cities, the inferiority of the local hinterland of New York becomes evident (Figs. 14, 15, 16). Although the population of Boston city never approached that of New York, the local hinterland of the former exceeded in population that of the latter until 1810. The

* Hazard, Vol. V, p. 77; p. 45.

† Tonnage owned (1810):

New York.....	268,548.1
Boston.....	149,121.85
Philadelphia.....	125,258.15
Baltimore.....	103,444.69
Charleston.....	52,888.16

Pitkin, Statistical View of the Commerce of the United States, 1817, p. 430.

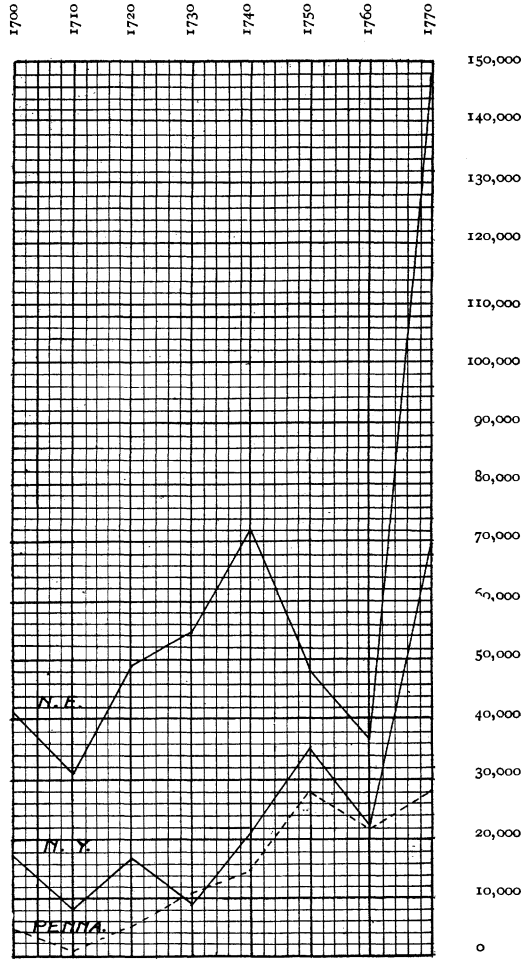


FIG. 12.—Colonial Exports of New England, New York and Pennsylvania; values in pounds.
Compendium of the 7th Census, page 184.

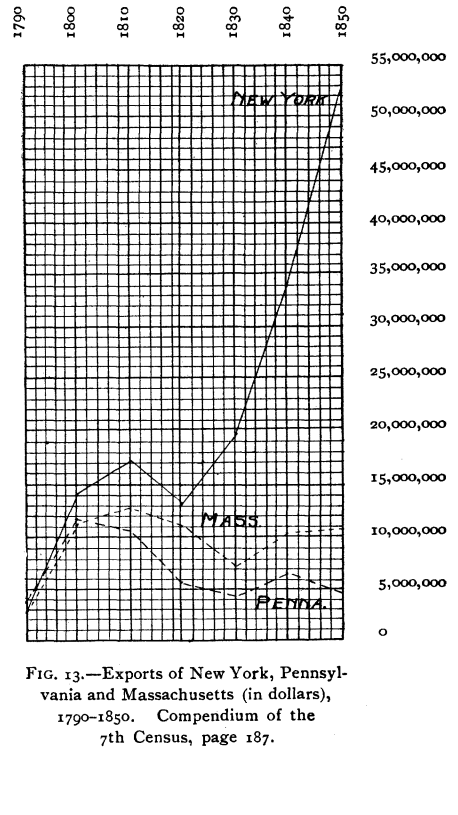


FIG. 13.—Exports of New York, Pennsylvania and Massachusetts (in dollars), 1790-1850. Compendium of the 7th Census, page 187.

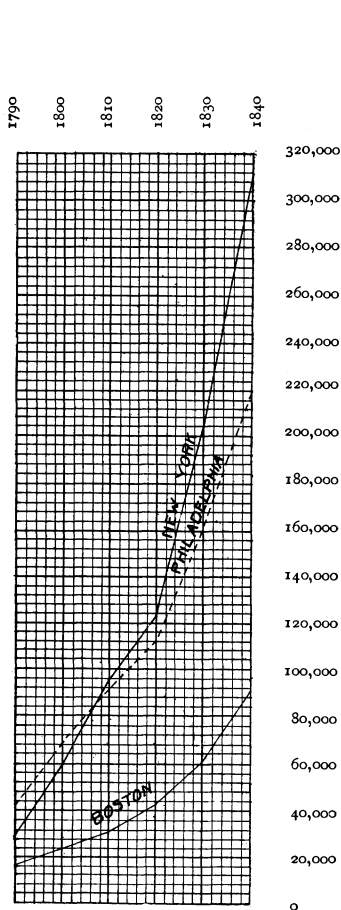


FIG. 14.—Populations of New York, Philadelphia and Boston, 1790 to 1840. Compendium of the 7th Census, page 192.

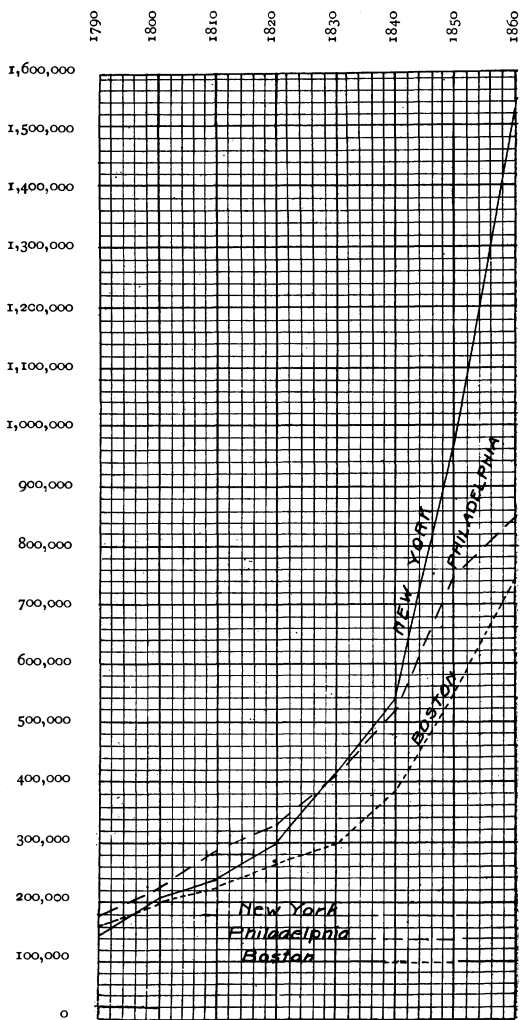


FIG. 15.—Populations of New York, Philadelphia and Boston, including the population of the region within a radius of 25 miles from these cities.

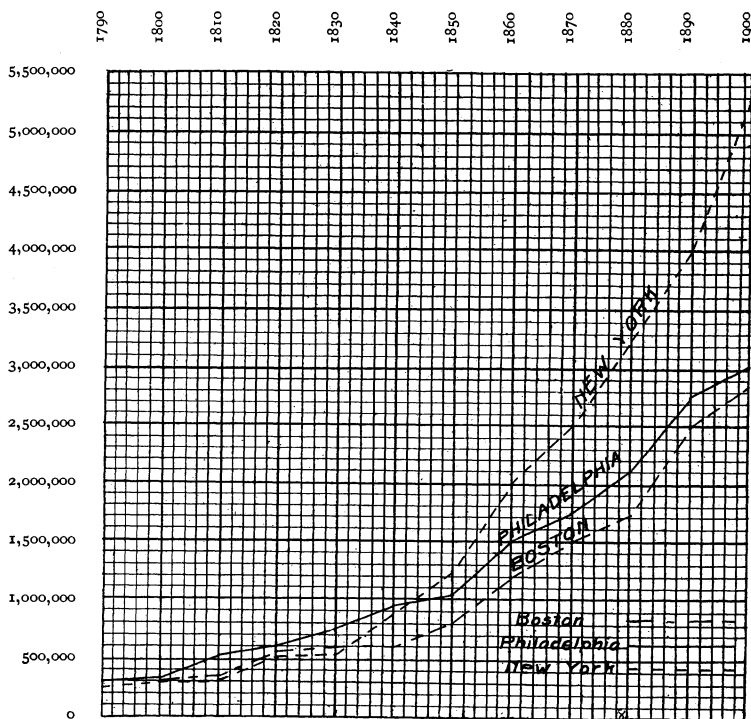


FIG. 16.—Population of New York, Philadelphia and Boston, including the population of the region within a radius of 50 miles from these cities.

graphs tell a similar story in regard to Philadelphia, the population of whose local hinterland exceeded that of New York until about 1840.

The same conclusion is emphasized in a comparison of the agricultural products of the three local hinterlands. Taking the figures from the censuses of 1850 and 1900, the following comparisons appear for a radius of fifty miles from each city:

	TOTAL ACRES IN FARMS.	NO. ACRES IMPROVED.	VALUE OF LAND AND IMPROVE- MENTS.	VALUE OF LIVE STOCK.	VALUE OF PROD- UCTS NOT FED TO LIVE STOCK.
New York:					
1850.....	....	2,242,682	\$154,526,972	....	....
1900.....	3,027,236	2,084,200	147,982,680	\$22,134,387	\$41,551,802
Philadelphia:					
1850.....	....	3,295,372	219,403,003	....	....
1900.....	4,951,030	3,947,574	218,520,630	37,589,050	68,397,797
Boston:					
1850.....	....	1,563,743	97,185,740	....	....
1900.....	2,588,835	988,807	81,296,400	14,164,423	30,617,432

Owing to changes in the enumeration in the different census reports, the figures given above are valuable chiefly for comparison at the time they were taken. It is to be noticed that the hinterland of Philadelphia, so far back as the census reports go, is more productive than that of Boston or New York. It is reasonable to suppose that these relative values were not very much different in the half century preceding 1850. Roughly speaking, the local hinterland of Philadelphia produces about one-third more in agricultural value than does that of New York. The comparison of the early trade and production of the local hinterland is not satisfactory, because of insufficient data. It would be interesting to trace the influence of each factor in the complex local hinterland of New York upon the development of the city, but this seems impossible to do—at least for Colonial times. The geographic factors, however, that were to influence most effectively the growth of the city, do not come into play until later times, when data are more abundant.

CANAL BUILDING.—The factors that located the Colonial ports of New York and Baltimore also directed the energies of those cities to reach the larger hinterland in the Mississippi Valley. The drowned river valleys near or upon which these ports are located, in their upper and middle parts, are transverse valleys across the Appalachian ridges. Back of Baltimore is the Valley of the Potomac; across the Piedmont from Philadelphia, the Susquehanna Valley leads into the Allegheny Plateau; and from New York, the Hudson estuary leads far north of the latitude of the low Appalachian ridges.

The easy passages across the Appalachian ridges are few. While the ridges are often steep and high, it was their number and the width of the ridge belt that made the crossing difficult. The trellised pattern of most of the streams made a zigzag path. When one ridge was crossed the valley beyond must be followed until a wind or water gap gave access to the next valley. It was a difficult journey even for the pioneer and his pack-horse. After the ridge belt was crossed, the Allegheny Plateau, with its early, maturely dissected surface, must be traversed. The valleys were narrow, and often had no flood plain to afford an easy path. The streams were swift and subject to sudden floods. The plateau offered but little inducement to settlers, and, consequently, there were but few places where the traveller could secure supplies.

The feasibility of the Potomac route to the West was noticed

by Washington in 1754 when he was a member of Braddock's army. The route up the Potomac to Cumberland, and from thence northward down the tributaries of the Ohio to that river, became a much-travelled road. As early as 1785 the States of Virginia and Maryland granted a charter to the Potomac Company, allowing it to improve the navigation of that river from tidewater to the highest practicable point, and from this point to construct a canal to Cumberland, Md.* The tolls of the canalized river reached their maximum of annual revenue of \$22,542.89 in 1811.† The project was not successful as a revenue producer, nor, of course, in reaching the trade of the West.

The next attempt of the Chesapeake States to reach the West was in 1828, when the Chesapeake and Ohio Canal was begun. The narrow flood plain of the Potomac offered a moderately easy path along which to dig the canal, although frequently rock was met in the digging and tunnelling was necessary. The steep slopes of the streams gave good opportunity for securing water for the canal by a system of dams, which, in the first construction, at least, was less expensive than a system of feeders from tributaries. The distance of the proposed canal to the Ohio Valley was less by more than a hundred miles than the successful Erie Canal.

It was not until 1850, however, that the Chesapeake and Ohio canal reached Cumberland in the heart of the ridge belt. The canal was constructed intermittently, often being delayed for want of funds. The folded structure, with its steep ridges, across which the canal had to pass after it left the Shenandoah Valley, could not support a dense or a productive population. Unlike the Erie Canal, which paid good dividends before it was completed, the Chesapeake and Ohio Canal project could not hope to pay dividends until it reached the Ohio Valley. Its supporters became discouraged at the constant outlay, and by the time the canal in its slow progress had reached the coal fields near the Allegheny Plateau, its competitor, the railroad, had anticipated the canal and secured the bulk of the coal trade which the canal was expected to secure. The canal was dug in the face of great geographic obstacles. Its returns were trifling in proportion to its cost, although the canal did great service in opening up the local hinterland of Baltimore.

Philadelphia had the way to the West pointed out by early wagon

* Milton Reizenstein, *The Economic History of the Baltimore & Ohio Railroad*, Johns Hopkins University Studies, 1897.

† Report on Canals, 10th Census, Vol. IV.

roads as well as by canals. The rolling Piedmont offered but little obstruction to road building, and the Lancaster pike—a well-built road—early connected Philadelphia with the town of Lancaster, a few miles east of the Susquehanna. The transverse and longitudinal Juniata valleys led to the Allegheny Front, where the ridge topography merges into the plateau topography. When this was crossed, valleys tributary to the Allegheny led down to that river.* Later the Forbes road gave a more direct wagon route across the mountains and plateau to Pittsburg. Along this road Philadelphia sent her drugs, hardware, and dry-goods to the Ohio Valley settlements.† By means of the Cumberland road, Baltimore was securing a large portion of the Pittsburg trade, and in 1791 the “Pennsylvania Society for Promoting the Improvement of Roads and Inland Navigation” made a favourable report on the feasibility of a canal route from Philadelphia to Pittsburg.‡ The report was based on surveys across the State. It was not until 1826, the year after the opening of the Erie Canal, that the Pennsylvania Canal was begun. Although the Schuylkill had been improved so that it was navigable to Reading, it was decided to cross the Piedmont from Philadelphia to Columbia by a railroad.

The physiographic obstacles to canal construction were difficult. The divide near the Allegheny Front was over two thousand feet above the sea-level. The descent westward from this divide was through narrow, steep-sloped valleys. The problem of water supply at the divide was so difficult that a portage railroad was built to connect the eastern and western divisions of the canal. Where the Juniata Valley was longitudinal, the valley was wide, the levels were favourable, and the canal could usually be dug in residual or alluvial materials. Where the valleys were transverse, there were often rapids, and the digging was often in rock. The steep Conemaugh Valley, through which the western division passed, required a large number of locks.

The railroad-canal route was completed in 1834, and Philadelphia was connected with Ohio. The State assumed the expense of construction, which amounted to \$14,361,320.32.§ The route had a considerable trade, although it did not, to any great extent, secure the grain trade of the Ohio Valley. The total revenue of the route from 1830 to 1860 was \$24,064,591, and the net revenue was

* Semple, E. C., *American History and its Geographic Conditions*, 1903, p. 65.

† J. B. McMaster, *History of the United States*, Vol. III, p. 481.

‡ Hulbert, A. B., *Great American Canals*, Vol. I, 1904.

§ Hepburn Report, Vol. V, pp. 23-4. The cost of construction is given as \$16,472,635 in volume IV. *Canals*, 10th Census, p. 8.

\$9,715,777.* It is interesting to note that of the total net revenue, \$4,802,419, or about one half, was earned by the eighty-one miles of railroad from Columbia to Philadelphia. The railroad crossed the well-settled and productive Piedmont, whereas the rest of the route, for the most part, crossed the ridge and plateau belt. Before the canal could share in the great iron and coal trade of the State, it had been superseded by the Pennsylvania Railroad, under the control of which it passed in 1857.

The most feasible route to the lands beyond the Appalachian barrier lay back of New York. The Appalachian ridges are low and the belt is narrow a short distance west of the Hudson. The Allegheny Plateau is dissected, and its north-south rivers are transverse to the route westward. But from the tidal Hudson normal, physiographic processes have provided the Mohawk Valley a trench which was of moderate slope (Fig. 17) and partially



FIG. 17.—Profiles of the Potomac River from Georgetown, Md., to Cumberland, Md.; of the Susquehanna-Juniata rivers from Columbia, Pa., to Huntington, Pa.; of the Mohawk River from its mouth to the vicinity of Rome, N. Y. All the diagrams have the same horizontal and vertical scales.

From "Profiles of Rivers in the United States," by Henry Gannett. No. 44 of the Water Supply and Irrigation Papers, U. S. Geological Survey, 1901.

aggraded by the outflowing Iroquois-Mohawk, which drained Lakes Warren and Iroquois. So obvious was the utility of this valley that, as early as 1724, nearly a century before the opening of the Erie Canal, Cadwallader Colden, Surveyor-General of the colony, suggested the possibility of a connection between the Mohawk and some tributary of Lake Ontario.† The plan was later urged by Washington and by Gouverneur Morris. In 1792 the project took more definite shape in the incorporation of two companies, the Western Navigation Company and the Northern Navigation Company—the one to connect the Hudson with Lake Ontario, and the other to connect the same river with Lake Champlain. The people of the State were awake to the importance of the project, and each company was to receive \$12,500 from the State as soon as it had invested \$25,000.‡

The principal work of the Western Navigation Company was to excavate a canal around Little Falls, where the canal crosses the

* Tenth Census, Vol. IV, Canals, p. 8.

† Poor's Manual, 1881, p. 4.

‡ Hulbert, Great American Canals, Vol. II, p. 22.

hard crystalline rock at the old fault line. This canal, 4,725 feet in length, was finished in 1795 at a cost of \$50,000.* The company, although it built insecurely and was obliged to expend much of its revenue on repairs, fared better than most of the canal companies of its day. Prior to the Revolution, the Mohawk Valley had been largely under the control of resident Indian tribes, who deterred both travel along that route and settlement of the region (Fig. 10). At this time settlers were entering the territory and in the following two decades it was rapidly settled (Fig. 11). Moreover, the gentle gradient of the Mohawk made it necessary to expend money on but few places, and the canal at Little Falls secured tolls on a large stretch of navigable water. The company actually paid considerable dividends. Meanwhile, a strong agitation had been continued for a canal connecting the Hudson and Lake Erie. It was delayed by the War of 1812, but under the leadership of DeWitt Clinton, the canal was begun by the State in 1818 and completed in 1825.

The geographic conditions were most favourable, and the building of the canal called for much less engineering ability and capital than did its less successful rivals, the Chesapeake and Ohio Canal and the Pennsylvania canals. The principal engineering difficulty was at Cohoes, where the canal drops one hundred and eighty-nine feet to the tidal Hudson, and at Lockport, where it drops sixty feet over the Niagara escarpment to the Ontario plain. East of Little Falls, the aggrading Iroquois-Mohawk had provided a level way, and on the famous Rome level in the old aggraded plain there is a sixty-mile reach without a lock. The alluvial deposits of the Mohawk Valley and the glacial and lacustrine soils of the Ontario plain did not offer notable difficulties in excavation. Indeed, in much of the course the principal difficulty was in removing the tree roots.

The problem of water supply over the summit level, which was such an obstacle to the canals in Maryland and Pennsylvania, was relatively simple in New York. For one hundred and fifty-five miles east of Buffalo the water for the canal comes from Lake Erie; the middle stretch from the Seneca River to Little Falls is fed from the numerous streams that rise in the Allegheny Plateau and flow northward into the Lake plain and upper Mohawk region; and the canal from Little Falls to the Hudson is fed largely from the Mohawk.†

* Hulbert, *Great American Canals*, Vol. II, p. 36.

† Tenth Census, Vol. IV, *Transportation Canals*, p. 2.

Considering the magnitude of the operations, the canal was finished with promptness, owing to favourable conditions for construction and also to the ability and vigor with which the enterprise was pursued. The canal cost \$6,916,402.47,* or an average of about \$20,000 per mile. The favourable physiographic conditions in the construction of the Erie Canal are emphasized by a comparison with its principal rivals:†

	LENGTH.	HEIGHT TO ASCEND.	AVERAGE COST PER MILE IN ROUND NUMBERS.
Erie Canal.....	399	5726	\$20,000
Penna. Canals & Railroad.	399	2291	41,000
Penna. Canal, main line..	277	....	30,000
C. & O. Canal.....	184.5	609	60,000

The census maps showed a rapid settlement of the canal zone in the decades 1810-20, especially in the eastern part (Fig. 11). It was in the line of westward movement from New England. The fertile lands were attractive and the navigable Mohawk gave communication. A notable response to these conditions is the promptness with which the canal was utilized. From 1820 to 1825, when the canal was opened, the tolls amounted to \$577,616—this, of course, being derived only from local traffic. The sudden magnitude of these local earnings must have surprised even the promoters of the canal.

* Hulbert, Vol. II., *op. cit.*, pp. 41-72.

† Compiled from Hulbert, Vols. I and II, and Vol. IV, Tenth Census.

(*To be Continued.*)

GEOGRAPHICAL RECORD.

AFRICA.

THE DUKE OF MECKLENBURG'S EXPLORATIONS IN CENTRAL AFRICA.—Early in 1907, Adolf Friedrich, Duke of Mecklenburg, left Germany for German East Africa, to carry out surveys and make zoological, geological, ethnographical and other researches. These labours were very successful and the party has returned to Germany by way of the Congo.

The Duke's scientific assistants were Lieut. Weiss, topographer; Dr. Kirchstein, geologist; Dr. Mildbread, botanist; Dr. Czekanowski, ethnologist; Dr. Schubotz, zoologist; and Dr. von Raven, physician. The starting-point of the exploratory work was Bukoba, the German port on the west coast of Victoria Nyanza, where the Duke and his party arrived on June 9, 1907.